



On The J-Curve Theory: The Literature and Further Proposed Improvements

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Abstract

As one of the most debated topics in international trade, the J-Curve theory has undergone several stages of improvement. This paper tracks those stages consecutively by evaluating the state of the literature. Previous literature and studies on the exchange rate movements on the J-Curve theory to achieved understanding of the effects of exchange rate movements on trade balance substantially which undergone several stages of improvement was gathered within period of 1973 – 2013. The study highlights the need for comprehensive studies assessing the overall effect of exchange rate depreciation on trade balance for one country and all of its major trade partners discretely on disaggregated level, i.e. the sector or commodity-level of trade. Although time-consuming and vast, this could be the only way for a country to draw a full picture for the impacts of its monetary policy on trade balance.

Keywords: Exchange rate, Trade balance, Devaluation, J-Curve theory, Monetary policy and trade.

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1. Introduction

Among all the theories discussing the effect of currency exchange rate movements on trade balance, there was one theory that got most of the attention, the J-Curve. The theory which relates prior approaches into a more complicated theory claims that the effect of exchange rate depreciation on trade balance is inconsistent and changes in direction over the course of time.

As first observed by Magee (1973) the phenomena suggests that trade balance is expected to deteriorate in the short-run as an instant reaction to currency devaluation. However, in the long-run, the trade balance recovers to higher level compared to its initial level when depreciation took place. This sequence of changes in trade balance over time can be likened to the capital letter J.

The reason why this theory has occupied most of the recent empirical literature concerning the relation between exchange rate movements and trade balance is its ability in testing other old approaches indirectly, while providing a novel approach to the issue by itself. For the case of Marshall-Lerner Condition, which claims that in order for a currency depreciation to have a favorable effect on trade balance, the elasticities of demand for imports and exports should exceed unity in absolute terms (Marshall and Groenewegen, 1923) a long-run improvement of the trade balance under the analysis of the J-Curve could indicate the Condition is met (Bahmani-Oskooee and Wang, 2008).

Another approach for the issue, known as the Elasticities Approach, was introduced by Bickerdike-Robinson-Metzler in the first half of the twentieth century (Hooy and Chan, 2008). The approach simply states that in order for the exchange rate depreciation to improve trade balance, the ultimate effect is determined by the interaction of the volume and value effects on trade flows. However, the J-Curve can also be understood in the same context.

In the short-run, the value effect hits fast by changing the prices of traded goods. The value of imports increase due to currency depreciation as paid in domestic currency, thus, the net exports decrease, causing trade balance to worsen. Nevertheless, the value effect itself leads the trade balance to improve in the long-run by changing the volumes of trade. It is caused simultaneously by a combination of two effects. First, domestic market starts to compensate the relatively high price of imports by consuming domestic production, and second, the exports start to increase given its newly high price-competitiveness in international markets.

However, although the J-Curve phenomena has improved the general understanding of the effects of exchange rate movements on trade balance substantially, the theory itself has undergone several stages of improvement. This study tracks the progress in the J-Curve analysis as summarized in Section [2]. While Section [3] concludes the study by proposing further improvements for the analysis to tackle with the challenges the J-Curve analysis is still experiencing until today.

2. Research Method

This paper is theoretical in nature and empirical method is being used to give account of the six distinct approaches of exchange rate movements on trade balance. Previous literature and studies on the exchange rate movements on trade balance was gathered within period of 1973 – 2013. Data and information are collected through the libraries, recognized journals both local and international. This simply suggests that secondary sources are predominantly used in the methodology of this study. The next section systemizes these studies into six different approaches of exchange rate movements on trade balance to ease the understanding of the historical improvement of the topic.

3. Tracking the Improvement of the J-Curve: A Literature Review Analysis

Since the idea of the J-Curve was introduced, numerous studies have attempted to test it. Bahmani-Oskooee and Hegerty (2010) divide these studies into three groups based on the data they employ: aggregate trade data, bilateral trade data, and a vastly growing number of studies on sector-level trade data. An examination of each of these three groups of studies is important because it helps to illustrate the evolution and the rationale behind the theory.

3.1. Stage One: Aggregate Trade Data

Earlier studies of the J-Curve employed aggregate trade data, which is the trade data of a country with all its trading partners, in order to examine the overall relationship between a country's trade balance and currency devaluation. The studies of Magee (1973); Himarios (1985) and Meade (1988) are examples investigated in the following.

Magee (1973) tested the effect of depreciation on trade balance in a study that introduced the J-Curve as a novel approach. This study analyzes three periods following depreciation or an appreciation; the currency-contract, the pass-through, and the quantity-adjustment periods. First period, the currency-contract, refers to the short period following a depreciation in which contracts are signed before the changes take place. Next period, the pass-through period, is when the depreciation has taken place and the contracts are signed based on the prices after the devaluation (the new prices). The behavior of trade balance in these two periods is the key to illustrate the short-run effects of currency devaluation on trade balance. The last period, quantity-adjustment period, is the period of price adjustment where the effect of currency depreciation on the quantities is taking place. Referring to this analysis, this study discusses the possibility of different effects of devaluation in short-run and long-run. In fact, in a successful currency depreciation, the trade balance worsening short-run will be improved in the long-run. The study also argues that “there may or may not be a J-Curve because the trade balance can change in either direction in each period”.

In another attempt, Himarios (1985) estimated the following linear trade balance model:

$$B_t = F(Y_t, Y_t^*, M_t, M_t^*, G_t, G_t^*, q_t, q_{t-1}, q_{t-2}, r_t) \quad [1]$$

Where the dependent variable (B) is the trade balance in foreign currency, Y (Y^*) represents the domestic (foreign) income, M (M^*) represents the domestic (foreign) money, G (G^*) represents the domestic (foreign)

government expenditure (which is replaced by the government consumption if the government expenditure is not available). q represents the real exchange rate, and finally r represents the opportunity cost of money. This study uses annual data for 10 countries over the period of 1956-1972, while the entire variables are in real terms. The dataset of this work is very close to the dataset used by Miles (1979) where he has studied Costa Rica, Finland, Ecuador, France, Iceland, Israel, Philippines, Spain, Sri Lanka, and UK.

Miles (1979) has concluded that there is not any evidence that currency devaluation will improve the trade balance although it would improve the balance of payments. But Himarios (1985) found a completely different results from the findings of Miles (1979). Based on his study, in nine cases out of ten, depreciation improves the trade balance in the long-run.

Meade (1988) in an investigation that used sectorial trade data, examines the relationship between the trade balance and exchange rates. This study applies quarterly data from 1968Q1 to 1984Q4 for the US, and its findings suggest no support for the J-Curve phenomena. The author believes that due to different structure and behavior of each sector, the response in a particular market may differ from the aggregate response. This study has focused on three sectors: non-oil industrial supplies, capital goods excluding automobiles, and consumer goods. The results support the objective of research, as when trade data at sector level is used, it is shown that each sector's responses to depreciation are quite different.

Meade (1988) recognized that the changes in exchange rate will affect the nominal trade balance both directly and indirectly. The direct channel is through export and import prices, and indirect channel is through the response of export and import volume to an alteration in relative prices. She emphasizes; "that the more quickly import prices respond to the changes in exchange rate and the more slowly import and export volumes adjust, the larger will be the initial worsening of the nominal trade balance and the longer will be the delay before a net improvement" (P. 635).

There are more studies in literature that used aggregate trade data to explain the relationship between a country's trade balance and currency depreciation (Bahmani-Oskooee and Alse, 1994; David et al., 1994; Brada et al., 1997). Generally, the findings based on aggregate trade data are old, mixed, and ambiguous where the significance of the J-Curve phenomena can poorly be defined.

3.2. Stage Two: Bilateral Aggregate Trade Data

The second group of studies that employs bilateral trade data tries to reduce the possible impact of "aggregation bias" and the measurement problems by choosing specific pairs of countries. The existence of the aggregating bias problem, which is one of the drawbacks of the first group of studies, may be the result of different nature of trade in each pair of countries. There is a possibility that the J-Curve phenomena exists between a country and one of its trading partners, while there is not any significant relationship between the exchange rate depreciation and the trade balance with the other trading partners.

Hence, considering this possibility, an insignificant relationship with one partner can offset a significant relationship of the exchange rate and the trade balance with another trading partner. Furthermore, using the aggregate data to examine the J-Curve theory may need to proxy the trade data for the rest of the world if it is not available. Therefore, another advantage of using bilateral level trade data could be the reduction of some measurement problems in comparison with applying aggregate data.

For the second group of studies we refer to Rose and Yellen (1989); Marwah and Klein (1996); Bahmani-Oskooee and Brooks (1999) and Dhasmana (2012).

Rose and Yellen (1989) investigate the bilateral J-Curve between the US and their trade partners. They specify the equations for the demand and supply of import. They followed the well-known Marshallian demand analysis in which the demand for imports by the home (foreign) country is determined by the domestic (foreign) income and the relative price of imported goods. Obviously, an increase in domestic (foreign) real income leads to an increase in the volume of import demand by the home (foreign) country, and also, an increase in the relative price decreases the volume of import demand. The demand for imports is expressed as:

$$D_m = D_m(Y, P_m) \text{ and } D_m^*(Y^*, P_m^*) \quad [2]$$

Where $D_m(D^*_m)$ represents the quantity of goods imported by the home (foreign) country; $Y (Y^*)$ represents the level of real income that is measured in domestic (foreign) output; P_m represents the relative price of imported goods to domestically produced goods in home currency; and P_m^* represents the analogous relative price of imports abroad.

Assuming perfect competition, the equations for the supply of exportables is specified as follows:

$$S_x = S_x(P_x) \text{ and } S_x^* = S_x^*(P_x^*) \quad [3]$$

Where $S_x, (S^*_x)$ represents the supply of domestic (foreign) exportables. P_x represents the home country relative price of exportable defined as the ratio of the domestic currency price to exportables (p_x) to the domestic price level (P); and p_x^* represents the foreign country relative price that is defined as the ratio of foreign currency price of exportables (P_x^*) to the foreign price level (p').

In the following, the domestic relative price of import is written as:

$$P_m = E \frac{P_x^*}{P} = \left(\frac{EP^*}{P} \right) \left(\frac{P_x^*}{P^*} \right) = REX P_x^* \quad [4]$$

Where E represents the nominal exchange rate that is defined as the domestic currency price of foreign exchange; and REX represents the real exchange rate that is defined as $E (p^*/P)$.

Correspondingly, the relative price of imports abroad is written as:

$$P_m^* = P_x / REX \quad [5]$$

Two equilibrium conditions determine the quantities of trade and the relative prices of exported goods in home and foreign countries in equilibrium:

$$D_m = S_x^* \text{ and } D_m^* = S_x \quad [6]$$

B which represents the value of the home country's balance of trade in real terms is shown by the value of net exports in home currency divided by P :

$$B = P_x D_m^* - REX P_x^* D_m \quad [7]$$

Thus, the trade balance B that is written as a 'partial reduced form', is a function of real exchange rate, the domestic and foreign income:

$$B = B (REX, Y, Y^*) \quad [8]$$

Rose and Yellen estimate a log-linear approximation of the above trade balance model, which is determined as follows:

$$TB_{jt} = a + bLnY_{us,t} + cLnY_{jt} + dLnREX_{jt} + \varepsilon \quad [9]$$

Where TB_{jt} represents the US trade balance with country j , Y_{us} represents the US real GNP, Y_j represents trade partner j 's real GNP (or GDP) and REX_{jt} represents the real exchange rate between the US dollar and j 's currency. This study has applied the quarterly bilateral trade data for the period of 1960 to 1985 for the US and its six G-6 trading partners (Canada, France, Germany, Italy, Japan and UK). They have found no significant effect of the exchange rate on the trade balance for any lag length, but for the case of Italy and Germany. The negative findings of this study are interpreted as a result of the potential simultaneity of the trade balance, exchange rates and outputs in one hand, and presence of unit-roots in the variables on the other hand. Also, they come up with a suggestion about taking each individual assumption such as; a short-run inelastic response of the import quantity to import prices, a short-run elastic response of the import prices to the exchange rate, and a slow response of the export quantity to the exchange rate, into account that collectively will give rise to the J-Curve.

Another study which took bilateral trade data is done by [Marwah and Klein \(1996\)](#). The study uses quarterly data of Canada and the US with their five largest trading partners (US/Canada, France, Germany, Japan and UK) for the duration of 1977-1992. They estimate the trade balance (US/Canada exports over US/Canada imports) which is a function of the real exchange rate and the quantity of world trade in the constant ratio of 1985 as US dollar over US/Canada GNP. This study has found the evidences of the J-Curve for both US and Canada.

[Bahmani-Oskooee and Brooks \(1999\)](#) in another study based on bilateral trade data, investigated the drawbacks in the analysis of [Rose and Yellen \(1989\)](#) and [Marwah and Klein \(1996\)](#). They point three deficiencies in the study of [Rose and Yellen \(1989\)](#) first, the sensitivity of findings to the units of measurement as in this study the trade balance is described as the difference between merchandise exports and imports, secondly, it is claimed that their cointegration technique (Engle-Granger) has low power as it requires the Dickey-Fuller (DF) or the augmented Dickey-Fuller (ADF) tests. Then, the short-run results are from a simple autoregressive analysis, rather than error-correction modeling; and third, they do not attempt to use any objective criterion to select the lag length in estimating their VAR model. The major deficiency for [Marwah and Klein \(1996\)](#) is using non-stationary data. [Bahmani-Oskooee and Brooks \(1999\)](#) avoid the shortcomings of these studies and examine bilateral J-Curve between the US and her six major trading partners (Canada, France, Germany, Italy, Japan, and UK). They adopt a model similar to the model used by [Rose and Yellen \(1989\)](#) which is specified as follows:

$$Ln TB_{jt} = a + bLnY_{US,t} + cLnY_{jt} + dLnREX_{jt} + \varepsilon_t \quad [10]$$

Where trade balance is denoted as TB_{jt} . Contrasting [Rose and Yellen \(1989\)](#) TB is the ratio of the imports from trading partner j over the exports to j . $Y_{US,t}$ is the index of the US real GDP, Y_j is the index of j 's GDP, while REX_{jt} is the real exchange rate defined as number of US's currency per trade partner j 's currency. Under this definition, the expected sign of d is positive if real depreciation is to improve trade balance.

Moreover, they employed the new cointegration technique of autoregressive distributed lag (ARDL). In order to capture the short and long-run effects, the model is put then in Error Correction Model format. The specification of [Bahmani-Oskooee and Brooks \(1999\)](#) takes the following form:

$$\Delta LogTB_{jt} = \alpha + \sum_{i=1}^n b_i \Delta LnTB_{t-i} + \sum_{i=0}^n c_i \Delta LnY_{us,t-i} + \sum_{i=0}^n d_i \Delta LnY_{j,t-i} + \sum_{i=0}^n f_i \Delta LnREX_{j,t-i} + \delta_1 LogTB_{t-1} + \delta_2 LogY_{us,t-1} + \delta_3 LogY_{j,t-1} + \delta_4 LogREX_{j,t-1} + \mu_i \quad [11]$$

By employing quarterly bilateral trade data from 1973Q1 to 1996Q2, they find no specific short-run patterns supporting the J-Curve, that is short-run negative sign for the coefficient of REX (d) followed by a positive sign. But they show that a real US Dollar depreciation has positive long-run impact on trade balance of the US.

The uniqueness of the work done by [Dhasmana \(2012\)](#) is the use of panel data analysis in bilateral trade data. The study covers the period of (1975-2011) using aggregate quarterly data of India's bilateral trade with her major 15 trade partners.

Although hard to justify, [Dhasmana \(2012\)](#) believes that although the direction of the relationship between real exchange rate and trade balance in the short-run might differ from a country to another or a commodity to another, the relationship is still homogenous in the long-run (depreciation should improve trade balance). Thus, the coefficient estimates of this approach are more accurate.

By using real effective exchange rate instead of bilateral real exchange rate, [Dhasmana \(2012\)](#) concludes that there is a strong positive relationship between real exchange rate depreciation and trade balance.

Like the first group, the findings of the second group are still highly inconsistent and still expected to suffer from aggregation bias since they used aggregate trade data instead of sectorial or commodity trade data.

3.3. Stage Three: Bilateral Disaggregated Trade Data

The third and most recent group of studies focus the analysis on commodity and sectoral trade data, with the intention of further reducing the aggregation bias. There can be no reason why each bilateral sector of trade should respond in the same way to depreciation. [Doroodian Sr et al. \(1999\)](#) for example call attention to the fact that the payments for agricultural goods are mainly made upon delivery, thus, the delivery lags are longer than those for manufactured goods. They argue that "it is thus plausible to test hypothesis that the J-Curve effect is more pronounced for agricultural goods than for manufactured commodities". There has been many studies that can be categorized in this group i.e. [Carter and Pick \(1989\)](#); [Doroodian Sr et al. \(1999\)](#); [Baek \(2007\)](#); [Bahmani-Oskooee and Wang \(2008\)](#) and [Bahmani-Oskooee and Zhang \(2013\)](#).

As pointed out by [Bahmani-Oskooee and Hegerty \(2010\)](#) "aggregate or bilateral studies often arrive at ambiguous or conflicting results, or sometimes even no results at all". Therefore, some researchers have disapproved the use of this data since it might hide significant information. For instance, One bilateral flow, say imports, might show a positive response to depreciation, while exports might show a negative one. When the two results are combined, as done in aggregate level, these responses might "cancel each other out, causing a single unimportant effect. Disaggregating trade data into industries has been recommended as a way to reveal significant results that are unnoticed at higher levels of aggregation. Here is a quick summary of this growing trend in the literature.

However, it should be noted that the term "commodity-level" seems to hold a blurry meaning. In many studies, it is used while it refers to a group of commodities instead of a single commodity i.e. *soap, cleansing and polishing paper* is described as a single commodity by [Bahmani-Oskooee and Wang \(2008\)](#). In some other studies, the term is more appropriately seen as "industry level" ([Ardalani and Bahmani-Oskooee, 2007](#)). However, both terms are used interchangeably ([Bahmani-Oskooee and Hosny, 2013](#)). Nevertheless, in other cases, the investigated commodity is a single commodity i.e. *tomatoes* as done by [Alias et al. \(2012\)](#). The reason of this mingling might be attributed to the source of data. There are mainly two widely-used sources of commodity trade data, the Harmonized Commodity Description and Coding System (HS), and the Standard International Trade Classification (SITC). Each nomenclature follows a distinct definition of sectors and commodities while both are recognized as commodity classification systems. In this study, we conform the term of "sector-level" of Trade.

[Carter and Pick \(1989\)](#) study the short-run adjustment path for the effect of currency devaluation by testing the pass-through effect. The paper concentrates on export as well as import unit values and net impacts of this adjustment. They use quarterly data from 1973 to 1985 and estimate the following model of trade balance (TB_i):

$$TB_i = X_i(1 + XV_i^*) - M_i(1 + MV_i^*) \quad [12]$$

Where X_i (M_i) is the agricultural exports (imports) value, XV_i^* (MV_i^*) denotes the assessed effect of a depreciation on the export (import) unit value. It should be noted that in their above trade balance model in the short-run, they assume that changes in exchange rate are independent from the volume of trade. Thus, the effect of devaluation on the agriculture trade balance is measured through its impact on the agricultural merchandise unit values. They conclude that agricultural import unit value adjust much faster than agricultural export to a depreciation. They also suggest that "the first segment of J-Curve does exist for the US agricultural trade balance; and with a 10% depreciation, the trade balance will initially decline for about nine months" (P. 719).

In a further development, [Doroodian Sr et al. \(1999\)](#) examined the J-Curve phenomena for agricultural and manufactured goods in the US by employing quarterly data from 1977Q1 to 1991Q4. The trade balance TB_i is modeled as in the following equation:

$$TB_{t,j} = \alpha_0 + \alpha_1 Y_t + \alpha_2 Y_{t,j}^* + \alpha_3 MB_t + \alpha_4 MB_{t,j}^* + \alpha_5 G_t + \alpha_6 G_{t,j}^* + \gamma B_t E_{t,j}^* + U_{t,j} \quad [13]$$

Where Y is the US real output, G is the US budget surplus/deficit, MB is the US money base, and E^* is the real effective exchange rate. All, Y^* , MB^* , and G^* are weighted averages calculated on the basis of the bilateral trade share in each group of commodities (agricultural and manufactured goods). The included countries are the most important 9 trade partners of the US.

The paper also suggests the presence of J-Curve phenomena for agricultural goods, but fails to support it for manufactured goods. The contradictory results for the different groups of commodities, according to them, are indicative for the need for further data disaggregation in the J-Curve analysis.

[Baek \(2007\)](#) investigates a single sector of industries, the US-Canada bilateral trade of five forest products. Using quarterly data from 1989Q1 to 2005Q1 and trade data obtained from the Foreign Agricultural Service (FAS Online), the study finds no support for the J-Curve applying the ARDL cointegration approach.

In a broader study, [Ardalani and Bahmani-Oskooee \(2007\)](#) examined the US bilateral trade with the rest of the world as a single trade partner of 66 sectors (SITC three-digit codes). They also apply the ARDL to monthly data (Jan 1991-Aug 2002). Although 22 sectors seem to have favorable long-run results, only six have the short-run succession of coefficients that support the J-Curve.

Therecent trend of disaggregating trade data has enabled an extended series of inclusive studies at the industry level of bilateral trade. [Bahmani-Oskooee and Bolhasani \(2008\)](#) for instance, find that for a set of 152 SITC three-digit trade flows between the US and Canada, 50% only have long-run effect. However, most sectors have some short-run effects.

Similarly, [Bahmani-Oskooee and Wang \(2007\)](#) study 108 SITC industries from 1962 to 2003 between the US and Australia. The study findings that 68 have significant short-run effects, while merely 35 have positive long-run effects.

For the US and China, [Bahmani-Oskooee and Wang \(2008\)](#) prove the presence of the J-Curve in 22 of 88 bilateral trade flows. The data is of two and three-digit SITC and extends over the period 1978-2002 annually.

Likewise, [Bahmani-Oskooee and Hajilee \(2009\)](#) studied trade between the US and Sweden for 87 sectors from 1962 to 2004. Employing annual data, while 50 percent of the industries have short-run significant effects, seven have a short-run pattern of coefficients suggesting the J-Curve, while 23 sectors have significantly positive long-run relations.

In an even more inclusive study, [Bahmani-Oskooee and Kovryalova \(2008\)](#) examine the US-UK trade using 177 SITC sectors from 1962 to 2003. Most industries, 107 industries, show short-run effects, and 66 register long-run effects.

Similar effects are uncovered for US-Japanese trade, as [Bahmani-Oskooee and Hegerty \(2009\)](#) find positive long-run coefficients for 41 of 117 industries but very little evidence of any “J-Curve”.

Furthermore, [Bahmani-Oskooee and Mitra \(2009\)](#) investigate the case of India. The paper uses annual trade data between India and the US for 38 sectors and show that real depreciation of the rupee has short-run effects in most industries (22 sectors), only eight sectors show a J-Curve pattern.

In one of the most recent studies, [Bahmani-Oskooee and Zhang \(2013\)](#) investigated the existence of the J-Curve between China and the UK. Using Out of the 47 sectors considered from 1978 to 2010, they show that the currency devaluation has favourable short-run effects in 38 industries. Nevertheless, the short-run impacts last into the long run in seven cases only.

However, it should be noted that for almost all the studies investigated in the third group, the sector-level, the employed methodology for cointegration was Autoregressive Distributed Lag (ARDL). While many previous analyses of the J-Curve phenomena employed other cointegration techniques, the methods prior to ARDL suffered from certain problems. First, the order of integration might not be alike among all variables, which means that some variables might be stationary at level while some other variables become stationary after taking the first difference ([Bahmani-Oskooee and Hegerty, 2010](#)).

Secondly, the J-Curve process of short- and long-run dynamics might not be correctly captured if several procedures are needed to form an error-correction model (ECM). One procedure has become a norm-like for the J-Curve analysis because it successfully addresses these two problems ([Pesaran et al., 2001](#)) suppose X, Y, and Z are the domestic country’s GDP, partner country’s GDP, and the real bilateral exchange rate respectively:

$$\Delta X_t = \sum_{j=1}^{n_1} \alpha_j \Delta X_{t-j} + \sum_{j=0}^{n_2} \beta_j \Delta Y_{t-j} + \sum_{j=0}^{n_2} \gamma_j \Delta Z_{t-j} + \delta_1 X_{t-1} + \delta_2 Y_{t-1} + \delta_3 Z_{t-1} + \varepsilon_{t-1} \quad [14]$$

This specification presents a standard ECM, with the addition of a linear combination of lagged level variables as a direct substitute for the first lagged error term (ε_{t-1}) in the [Engle and Granger \(1987\)](#) formula. Cointegration can be tested by following these simple steps. First, the specification is tested without the lagged level variables. Then, the lagged level variables are added again and tested for joint significance with a special version of the F-test which new tabulated critical values are calculated by [Pesaran et al. \(2001\)](#) or [Narayan \(2005\)](#) for small samples. Significance indicates that there is a long-run association between variables, and thus cointegration.

Since equation [14] integrates the coefficients of the short- and long-run, it is perfectly appropriate to investigate the J-Curve phenomena. This can be captured by comparing the sign and the significance of the short-run coefficients at early lags with those at later lags. Contrary signs would indicate that the J-Curve or the inverted J-Curve (depending on the definitions).

Another way to trace the J-Curve is to compare the short-run coefficient with that of the long-run (In this case, the maximum number of imposed lags on first differenced variables should be one).

To summarize, the third stage of improvement has successfully tackled with two key points of the J-Curve analysis.

First, It showed that it is implausible to test the J-Curve on the aggregate level of trade since some trade sectors or commodities might be affected negatively by exchange rate depreciation while other sectors positively, hence, when studying the effect on aggregate level, the two contradictory relations might cancel each other out resulting in a no effect final estimation. Thus, to obtain more meaningful results, it's better to employ bilateral commodity trade data.

Second, the econometric techniques used in the J-Curve analysis in many studies employed some models that require pretesting for the unit root and were not able of detecting the short and long-run effects independently. As widely agreed by most of the recent studies, it is the best not to test for stationarity using any of the popular tests, but to establish cointegration by applying the Autoregressive Distributed Lag technique. To capture the time-dependent effects, it is applicable to use the Error Correction Mechanism.

4. Concluding Remarks and Further Proposed Improvements

As summarized in this study, the plausible theory of the J-Curve has undergone several stages of improvement. Where early studies used aggregate trade data between one country and all of its trade partners at a time, the bias of aggregation and exogeneity led a group of other researchers to utilize the trade data bilaterally. To further reduce the bias, an enormous body of literature investigated the J-Curve bilaterally on disaggregated level of trade, i.e. sector and commodity-level.

However, even with these improvements, the J-Curve theory is still one of the most debated topics in this field. The most significant question the J-Curve is still facing could be stated as follows; what is the overall effect of exchange rate movements on trade balance for a certain country?

Since the effects of exchange rate movements on trade balance are not expected to be homogenous in different bilateral relations, i.e. different levels of development and economy structure, and on the other hand, the same effects are not expected to be homogenous indifferent commodities either, more comprehensive sector-level studies on the J-Curve for a country and its major trade partners separately should be conducted to function as a frame of reference for monetary policymakers.

To tackle with this new perspective, a novel phase of improvement for the J-Curve analysis could be triggered. By doing so, we can indeed capture the effect of exchange rate movements on trade balance in major bilateral relations of a country and specific commodities, which permits new bidirectional comparisons over sector and trade partner.

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